Suggestion of a Method of Imitating the Transit of a Planet over the Sun. By the Rev. T. R. Robinson, D.D., F.R.A.S., &c.

While reading Mr. Stone's admirable papers on the transit of *Venus*, it occurred to me that experimental information as to the "black drop," which plays so important a part in this inquiry, may be obtained by means which I formerly used in some researches on irradiation, that were published in the 5th volume of the Society's *Memoirs*.

To obtain an artificial Sun I fixed a plate of brass, in which was a small circular aperture, in the focus of a good telescope. This was viewed, collimator-wise, with another telescope; and when illuminated by a lamp placed behind it, appeared as a luminous disk, 17′ diameter, sharply defined, and about as bright as the Sun was in the transit instrument. By interposing a piece of oiled paper the disk became much fainter, though the wires in the micrometer of the observing telescope were quite distinct. Making them internal tangents to the disk, and withdrawing the oiled paper, the limbs projected outside the wires from two to three seconds by the effect of irradiation.

Now an artificial planet may be obtained in two ways. 1. A small opaque disk may be carried by the frame of a micrometer in the observing telescope; it will appear as a black spot on the luminous disk, which can be moved at pleasure. Making the illumination of the aperture as faint as is consistent with distinct vision, the circumference can be brought into *real* contact and the corresponding micrometer reading noted. Then, using the full illumination, I expect that the "black drop" would appear, and that an *apparent* internal contact could also be produced. If the arm carrying the opaque disk be supposed likely to interfere with an exact appreciation of the phenomena, it might be supported by a central perpendicular wire an inch or two above the micrometer frame.

2. Or, which seems preferable, the opaque disk may be placed within the aperture in its plane, and moveable in that plane by a micrometer attached to the collimating telescope. This plan has the advantage that both Sun and planet are formed under precisely similar optical conditions, and that the apparent motion of the latter can be more conveniently imitated by attaching a driving-clock to the micrometer-screw.

The precautions which were required to give the aperture an edge which can bear high magnifying, are described in the paper referred to, and they would probably suffice to give an exact metal disk. I would, however, prefer one formed by drilling a conical hole through two pieces of glass cemented together, as described for the aperture; on separating them the edges of the sections which had been in contact would be as smooth as art can make them, and by filling one of them with black cement, a true

disk would be obtained, which could be placed exactly in the plane of the sun-aperture. The glass should be attached to the micrometer-frame, and thus no disturbance of the images by any influence of a support could occur.

If the illumination were made by magnesian or electric light, this apparatus would be also available for Photographic experiments on the Transit.

On the Increase of Probable Errors in a Transit of Venus as dependent upon the Smallness of Normal Velocity. By E. J. Stone, Esq.

In the *Monthly Notices* for April there appears a short paper of mine, "On the Comparative Clinging of the Limbs of *Venus* and the Sun in the Transit of 1874," and some consequences which appeared to follow therefrom.

In discussing the observations made in 1769, I convinced myself that the chief source of error to be feared was erroneous assumption of semidiameter. The errors arising from causes which chiefly affect ordinary transit-observations, such as errors in subdividing seconds of time, loss of time in mechanically registering impressions conveyed through the eye to the mind, &c. sink into insignificance compared with the three or four seconds which we had to allow for the probable error of a contact observation.

In observations of this kind the observers have to seize some well-marked phases of the gradual destruction of, and restoration of, the irradiation near the point of contact of the Sun's limb. The appearances are complicated by considerations of atmospheric disturbances, aperture of telescope employed, density of absorbing medium made use of to reduce the Sun's glare, eye of the observer, defining character of the telescope, and the power employed. But, under given conditions, the phenomenon — as, for instance, real contact or total disappearance of connecting ligament — will take place with a definite angular separation between the limbs.

If the attention is drawn to the first appearance of, or disappearance of, the connecting ligament, then that ligament must have a definite breadth, in order that, under the given circumstances of observation, it may be visible by contrast upon the Sun's disk. The question of seeing the ligament is not a question of sufficient time to enable us to pick it up, but of sufficient optical means to distinguish it. Such, at least, was and is my own opinion.

In the transit of *Mercury*, 1868, November, Mr. Carpenter, observing at Greenwich with a small telescope and low power, about 90, states that "the black ligament appeared to form *in-*